

## BIOGRAPHICAL SKETCH

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NAME: Rathbun, Colin Michael

eRA COMMONS USER NAME (credential, e.g., agency login): colinrathbun

POSITION TITLE: Postdoctoral Researcher

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Hope College, Holland MI	B.S	05/2012	Chemistry
University of California, Irvine	Ph.D.	05/2018	Organic Chemistry
University of Colorado, Boulder	Postdoctoral	05/2020	Chemical Biology and Fluorescence Imaging

### A. Personal Statement

Methods and tool development have characterized my academic career and continue to inspire my future work. Throughout my undergraduate and graduate work I enjoyed designing solutions to problems in both organic chemistry and chemical biology. My undergraduate research involved development and study of new transition-metal catalyzed reactions involving carbon-carbon bond activation. Under the mentorship of professor Jeffrey Johnson, this work lead to some of the first kinetic characterizations of C-C bond activation reactions. During the summer of 2011 I had the opportunity to conduct research in Buenos Aires, Argentina through an NSF REU grant. In graduate school, I continued similar work in organometallic catalysis during my first two years in the lab of Professor Vy Dong. My work in the Dong Lab sought efficient transformations for the synthesis of carbohydrates; a longstanding problem in organic chemistry. Following advancement, I moved to the Prescher lab to pursue the development of new tools for bioluminescence imaging. In the subsequent three years, I developed a new screening platform and image analysis techniques. During my postdoc in the Palmer lab, I developed a modular synthesis for a new class of fluorescent RNA imaging probes. I evaluated these probes using single-molecule TIRF imaging. My new probes improve on previous designs by reducing molecular weight and increasing cell permeability. These designs will inspire the next generation of RNA imaging probes in the Palmer lab. My independent work at Dickinson will integrate my expertise in mechanistic investigation and my passion for protein engineering and tool development. Researchers in my lab will design and evolve new protein-small molecule interactions that will contribute new molecular tools and increase understanding of protein-ligand interactions.

1. Braselmann, E.; Rathbun, C. M.; Richards, E. M.; Palmer, A. P. "Illuminating RNA biology: Tools for imaging RNA in live mammalian cells." *Submitted to Cell Chemical Biology. Invited review.*
2. Rathbun, C. M.\*; Porterfield, W. B.\*; Jones, K. A.\*; Sagoe, M. J.; Reyes, M. R.; Hua, C. T.; Prescher, J. A. "Parallel screening for rapid identification of orthogonal bioluminescent tools." *ACS Cent. Sci.*, **2017**, 3, 1254.
3. Chen, I. H.; Kou, K. G. M.; Le, D. N.; Rathbun, C. M.; Dong, V. M. "Recognition and Site-Selective Transformation of Monosaccharides by Using Copper(II) Catalysis." *Chem. Eur. J.*, **2014**, 20, 5013.
4. Rathbun, C. M.; Johnson, J. B. "Rhodium-Catalyzed Acylation of Quinoliny Ketones: Carbon-Carbon Single Bond Activation as the Turnover Limiting Step of Catalysis." *J. Am. Chem. Soc.*, **2011**, 133, 2031.

## B. Positions and Honors

### Positions and Employment

2010 – 2012	Undergraduate Researcher, Department of Chemistry, Hope College, Holland, MI
2010	Undergraduate Researcher, University of Buenos Aires, Buenos Aires, Argentina
2012 – 2018	Graduate Researcher, Department of Chemistry, University of California, Irvine
2018 – 2020	NIH Postdoctoral Fellow, Department of Biochemistry, University of Colorado, Boulder
2020 –	Assistant Professor, Department of Chemistry, Dickinson College, Carlisle, PA

### Honors

2008	Presidential Scholarship, Hope College, Holland, MI
2009	Jaeker Chemistry Scholarship, Hope College, Holland, MI
2009	Chemistry Dept. J. H. Kleinheksel Award, Hope College, Holland, MI
2011	NSF International REU, Buenos Aires, Argentina
2011	Barry M. Goldwater Scholarship
2012 – 2017	NSF Graduate Research Fellowship
2017 – 2018	Allergan Graduate Fellowship
2018	Edward K.C. Lee Departmental Research Award
2019 – 2020	Ruth L. Kirschstein National Research Service Award, NIH Postdoctoral Fellowship

## C. Contribution to Science

- Undergraduate Career:** My undergraduate contributions involved study of carbon-carbon bond activation with transition metals. C–C bond activation remains one of the final missing tools of organic synthesis. In the Johnson lab at Hope College. We studied a highly efficient C–C bond activation reaction catalyzed by a common Rhodium catalyst. Using novel kinetic techniques, I showed that C–C bond activation was the rate-determining step of catalysis, and reported the first energy of activation for this class of transformation. This work provided the field with crucial information regarding the mechanism of these reactions, and will inspire new catalytic transformations to expand the organic chemist's toolkit.
  - Lutz, J. P.; Rathbun, C. M.; Stevenson, S. M.; Powell, B. M.; Boman, T. S.; Baxter, C. E.; Zona, J. M.; Johnson, J. B. "Rate-Limiting Step of the Rh-Catalyzed Carboacylation of Alkenes: C-C Bond Activation or Migratory Insertion?" *J. Am. Chem. Soc.*, **2012**, *134*, 715.
  - Rathbun, C. M.; Johnson, J. B. "Rhodium-Catalyzed Acylation of Quinoliny Ketones: Carbon-Carbon Single Bond Activation as the Turnover Limiting Step of Catalysis." *J. Am. Chem. Soc.*, **2011**, *133*, 2031.
- Graduate Career:** In graduate school I developed new bioluminescent tools for preclinical imaging. Bioluminescent proteins are widely used for monitoring protein expression in a variety of environments. In many cases, bioluminescence is preferred over fluorescence due to its excellent sensitivity *in vivo* and *in vitro*. Unlike fluorescent probes, however, current bioluminescent tools lack the ability to track multiple subjects in tandem. In my graduate work, I developed the first engineered bioluminescent tools for multicomponent imaging. To find viable probes, I developed a new *in silico* screening technique. Once these probes were identified, I discovered a technique to distinguish them *in vivo*, and validated this method in mouse models.
  - Rathbun, C. M.\*; Ionkina, A. I.\*; Yao, Z.; Jones, K. A.; Porterfield, W. B.; Prescher, J. A. "Rapid multi-component bioluminescence imaging via substrate unmixing." *bioRxiv*, **2019**, 811026. *Also submitted for peer review.*
  - Rathbun, C. M.\*; Porterfield, W. B.\*; Jones, K. A.\*; Sagoe, M. J.; Reyes, M. R.; Hua, C. T.; Prescher, J. A. "Parallel screening for rapid identification of orthogonal bioluminescent tools." *ACS Cent. Sci.*, **2017**, *3*, 1254.
  - Rathbun, C. M.\*; Jones, K. A.\*; Porterfield, W. B.\*; McCutcheon, D. C.; Paley, M. A.; Prescher, J. A. "Orthogonal Luciferase-Luciferin Pairs for Bioluminescence Imaging." *J. Am. Chem. Soc.*, **2017**, *139*, 2351.

- d. Steinhardt, R. C.; Rathbun, C. M.; Krull, B. T.; Yu, J. M.; Yang Y.; Nguyen, B. D.; Kwon, J.; McCutcheon, D. C.; Jones, K. A.; Furche, F.; Prescher, J. A. "Brominated Luciferins are Versatile Bioluminescent Probes." *ChemBioChem*, **2016**, 18, 96.

3. **Postdoctoral Career:** My postdoctoral work has focused on small-molecule fluorescent probes for imaging RNA in live cells. Though nearly 97% of RNA is untranslated, our understanding of the behavior and function of noncoding RNA remains limited. Modern tools for tracking RNAs in the cell require large protein tags that likely perturb RNA function. In the Palmer lab, I sought to develop new, nonperturbing probes for RNA imaging. I designed and synthesized two new classes of fluorescent RNA tags and tested them against existing techniques in a single-particle TIRF assay. My new designs hold promise in improving ease-of-use, as well as probe signal-to-background. Future work in the Palmer lab will test these scaffolds in live mammalian cells.

- a. Braselmann, E.; Rathbun, C. M.; Richards, E. M.; Palmer, A. P. "Illuminating RNA biology: Tools for imaging RNA in live mammalian cells." *Submitted to Cell Chemical Biology. Invited review.*

**Complete List of Published Work in MyBibliography:**

<https://www.ncbi.nlm.nih.gov/sites/myncbi/1IEq-HZAA5csye/bibliography/54605233/public/?sort=date&direction=ascending>

**D. Additional Information: Research Support and/or Scholastic Performance**

YEAR	COURSE TITLE	GRADE
HOPE COLLEGE		
2008	Calculus I	TR (AP credit)
2008	Calculus II	TR (AP credit)
2008	Multivariable Mathematics I	A
2009	Multivariable Mathematics II	A
2008	General Chemistry I	A
2009	General Chemistry II	A
2009	General Physics I	A
2009	General Physics II	A
2009	Organic Chemistry I	A
2010	Organic Chemistry II	A
2010	Inorganic Chemistry	A
2010	Inorganic Chemistry Lab	A
2010	Physical Chemistry I	A
2011	Physical Chemistry II	A-
2010	Structure, Dynamics, and Synthesis I	A
2010	Software Design & Implementation	A
2011	Data Structures & Software Design	A
2011	Statistical Methods	A-
2011	Applied Statistical Models	A
2011	Biochemistry I	A
2011	Analytical Chemistry	A
2012	Advanced Spectroscopy Lab	A
2010–2012	Independent Research in Chemistry	A
UC IRVINE		
2012	Organic Reaction Mechanisms I	A
2012	Organic Spectroscopy	A-
2012	Organometallic Chemistry	A-
2013	Organic Synthesis I	A-
2013	Chemical Kinetics	A-
2013	Biomacromolecules	A
2014	Chemical Biology	A